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ABSTRACT

Comprehension monitoring was investigated by asking college students to read and recall passages that contained intentionally introduced confusions (inconsistent information, unclear references, and inappropriate logical connectives). Subjects were then told that confusions had been present and were asked to describe them and comment on how they affected comprehension. Subjects failed to report a surprisingly large proportion of the confusions. Confusions involving main points were detected more frequently than those involving details, and confusions of inconsistent information and unclear reference were more often reported than inappropriate connectives. Retrospective reports and analysis of the recall protocols revealed that failures to report confusions were often due not to failures to monitor comprehension but rather to the use of repair strategies to resolve the potential problems. (Author/RL)

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CENTER FOR THE STUDY OF READING

Technical Report No. 145

COMPREHENSION MONITORING: IDENTIFYING AND COPING WITH TEXT CONFUSIONS

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Abstract

Comprehension monitoring was investigated by asking college students to read and recall passages that contained intentionally introduced confusions. Subjects were then told that confusions had been present and were asked to describe them and comment on how they affected comprehension. Subjects failed to report a surprisingly large proportion of the confusions. Confusions involving main points were detected more frequently than those involving details, and confusions of inconsistent information and unclear reference were more often reported than inappropriate connectives. Retrospective reports and analysis of the recall protocols revealed that failures to report confusions were often not due to failures to monitor comprehension but rather to the use of repair strategies to resolve the potential problems.

Comprehension Monitoring: Identifying and Coping with Text Confusions

Comprehension monitoring involves the evaluation and regulation of one's own ongoing comprehension processes. To evaluate is to keep track of the success with which comprehension is proceeding, and to regulate is to ensure that the process continues smoothly, often by taking remedial action when comprehension fails. Thus, readers who monitor their comprehension of text know when they understand, when they don't understand, and when they partially understand. In addition, they know to test whether their understanding is adequate for the purpose at hand, and when and how to deal with comprehension difficulties. Despite the obvious importance of monitoring comprehension during reading, relatively little research attention has been directed to the process. A renewed interest in the cognitive processes underlying reading and the emerging area of inquiry known as metacognition have stimulated much theoretical speculation about the individual's awareness and control of his or her own comprehension (e.g., Anderson, in press; Brown, in press; Collins, Brown, & Larkin, in press; Markman, 1977, in press, Meichenbaum & Asnarow, in press; Miller, 1976; Rumelhart, in press; Ruddell, 1976; Wertsch, 1978; Woods, in press; Flavell, Note 1; Markman, Note 2) but empirical investigations remain scarce.

Comprehension monitoring has been studied indirectly by asking people to reflect about their comprehension processes. Olshavsky (1976-77) and

Olson, Duffy, and Mack (Note 3) used the technique of protocol analysis, asking subjects to talk aloud about their thoughts and expectations as they were reading a passage clause by clause. Collins, Brown, and Larkin (in press), Smith (1967), and Strang and Rogers (1965) examined retrospective reports from subjects who were asked to talk about their reactions to a passage after they finished reading. Techniques such as these reveal the variety of strategies people use in their efforts towards comprehension, confirming Thorndike's (1917) early analysis of reading as a problem solving process. Moreover, the results suggest that poor comprehension monitoring may be characteristic of poor readers. Though good and poor high school readers did not seem to differ in their identification and resolution of comprehension difficulties at the level of words and clauses (Olshavsky, 1976-77), there were apparent differences in more sophisticated monitoring. Poor readers had less insight into the procedures they used during reading (Smith, 1967; Strang & Rogers, 1965) and were less likely to seek clarification of poorly understood information (Strang & Rogers, 1965).

Because the subjects in these experiments were specifically instructed to reflect on their comprehension processes, the studies provide little information about spontaneous comprehension monitoring. Moreover, the experimenters had no control over which specific sections of text readers might find confusing, and so it is difficult to draw conclusions about how effectively readers were monitoring their comprehension. These shortcomings can be remedied by manipulating the comprehensibility of the text itself; failures to notice deliberately introduced confusions may provide evidence

of poor comprehension monitoring. This paradigm has been used to study the development of comprehension monitoring skills (Markman, 1977, in press), as well as referential communication (e.g., Cosgrove & Patterson, 1978; Ironsmith & Whitehurst, 1978).

Markman's studies provided evidence of developmental differences in comprehension monitoring. In the 1977 study, children in first and third grades listened to simple instructions on how to play a game or perform a magic trick. In both cases, information was left out that was crucial to being able to follow the instructions. The children were told that their help was needed in coming up with good instructions and that they should let the experimenter know if something was omitted or was unclear. The instructions for the card game were as follows:

> We each put our cards in a pile. We both turn over the top card in our pile. We look at cards to see who has the special card. Then we turn over the next card in our pile to see who has the special card this time. In the end the person with the most cards wins the game.

There was no mention of what the "special card" might be. Markman found that the third graders realized the instructions were incomplete much more readily than the younger children. It was often not until the first graders physically tried to carry out the instructions that they realized they didn't understand. They may have felt they understood when in fact they did not, suggesting that they had been listening passively and not actively evaluating whether the instructions made sense.

Thus, Markman concluded that first graders did not monitor their comprehension effectively but that third graders did. However, it is relatively easy to test one's understanding of instructions because they can be evaluated by the success with which some goal is attained. Monitoring comprehension of text is more difficult because the criteria for successful comprehension are less explicit: Readers must decide for themselves how well they need to understand, selecting their own standards for evaluation. This suggests that the effectiveness of one's comprehension monitoring may depend not only on age but also on the nature of the materials. Markman (in press) provided supporting evidence for this suggestion. Children in third, fifth, and sixth grades listened to short essays containing inconsistent information and then answered questions designed to assess their awareness of the inconsistencies. Here is an example of one of the inconsistencies, taken from a passage about fish:

> Fish must have light in order to see. There is absolutely no light at the bottom of the ocean. It is pitch black down there. When it is that dark the fish cannot see anything. They cannot even see colors. Some fish that live at the bottom of the ocean can see the color of their food; that is how they know what to eat.

There is a conflict between statements that fish cannot see colors at the bottom of the ocean and that some fish can see the color of their food at the bottom of the ocean. Children in all grades tested were equally poor at noticing the inconsistencies. Thus, although third graders reported when

they did not understand instructions, children of the same age and older failed to report problems in the expository passages. However, when specifically warned that the passages contained inconsistencies, a greater proportion of children, primarily sixth graders, reported them. This is evidence that comprehension monitoring is facilitated when the criteria for evaluation are more explicit.

Markman's experiments supplement the abundant evidence of developmental differences in cognitive monitoring (e.g., Brown, 1975, in press; Flavell, 1978, Note 1; Flavell & Wellman, 1977). The studies discussed earlier are suggestive of individual differences as well: High school students who are poor readers seem to lack awareness of their cognitive processes during reading (Smith, 1967; Strang & Rogers, 1965). Similarly, adults engaged in novel activities may lack appropriate strategies for evaluating and regulating their performance, as Chi (1978) has shown with novice chess players. Quite clearly, cognitive monitoring is not an ability that simply develops with maturity, but is highly dependent on knowledge and experience (Brown & De Loache, 1978).

It is therefore somewhat surprising that instruction in comprehension monitoring is not typically included in school curricula. Despite some attention to the related areas of critical reading and study skills, children are left on their own to acquire expertise in this important component of reading. Since many students who have entered college still experience difficulty in the task of learning by reading (Anderson, in press), it may be that their comprehension monitoring skills are inadequate.

If poor comprehension monitoring does, in fact, occur in mature readers, then more attention should be devoted to the process throughout the school years.

The present study was a preliminary investigation of college students' comprehension monitoring abilities that combined two of the general paradigms previously described. Confusions were introduced into the text in order to pinpoint segments that should cause comprehension difficulties. Retrospective reports were collected in order to determine how the confusions affected the students' processing of the information. In addition, recall protocols were obtained to assist in discovering how the confusions were comprehended. Three different types of confusions were introduced into expository passages: (a) inconsistent information, where ideas in one sentence conflict with those of another (e.g., the word "backwards" was substituted for the word "advanced" in a sentence evaluating the Inca economy, while subsequent sentences continued to describe positive aspects of the economy); (b) unclear reference, where the context does not specify which of several previously introduced nouns is the referent of a nonspecific phrase (e.g., the phrase "one type of novel" was substituted for "the pastoral novel" in a context where three different novel types are under discussion); and (c) inappropriate logical connective, where expectations about the kind of information that will follow a particular connective are violated (e.g., the word "therefore" was substituted for the word "however").

The inconsistency confusions were included because an important aspect of comprehension involves integrating the ideas in different sentences into a meaningful whole. Conflicts between ideas should be noticed if readers are keeping track of their ongoing comprehension processes. The unclear reference problems were included because readers are often faced with the task of identifying anaphoric referents. Experiments have shown that subjects look back at previously read information and make regressive eye movements when dealing with anaphora (e.g., Carpenter & Just, 1977; Garrod & Sanford, 1977). Failures to notice vague referents should therefore be a good indication of failures to monitor comprehension carefully. The inappropriate connective confusions were included because an important aspect of comprehension is following the logical relationships among the ideas in a text. Signal words such as "therefore," "however," and "in addition" provide clues as to the type of information that should come next. Many guides to effective reading and study skills claim that attention to these transition words can be of great benefit to comprehension (e.g., Adams & Spira, 1978; Sparks & Johnson, 1971; Wood, 1978). If so, we would expect inappropriate signal words to be disruptive if readers are monitoring their comprehension.

A second manipulation in the study was the level of the confusion in the text structure; that is, whether it involved a main point or a detail. One of the most prevalent findings in research on prose memory is that main ideas are remembered better than details (e.g., Johnson, 1970; Kintsch, 1974; Meyer, 1975). Is this because main ideas are easier to retrieve or

because they are processed differently during reading? Carpenter and Just (Note 4) reported that subjects spent more time reading sentences containing main ideas than details, suggesting that the better memorability is in fact due to increased attention initially. This leads to the prediction that subjects should be more likely to notice confusions in main points than in details.

Method

Materials

The materials consisted of six 250-word passages that dealt with topics in world history. The passages were based on Cliff's Course Outline in World Civilization (Leon, 1970). Each of the three paragraphs in a passage focused on a separate aspect of the main topic. For example, in a passage about the Inca civilization, the first paragraph dealt with the ruler of the empire, the second with the economy, and the third with religion. The middle paragraph of each passage was modified to contain one of the three types of confusions described earlier: inconsistent information, unclear reference, or inappropriate connective. For each of the three confusion types, one passage contained a confusion at the main point level, while another contained a detail level confusion. The main point confusions were introduced near the beginning of the paragraphs and had bearing on the interpretation of the entire paragraph. The detail confusions appeared near the end of the paragraphs, and were related to only one or two other statements in the paragraph.[1] Table 1 presents the target (middle) paragraph from each of the six passages. The underlined sentence is that which

contained the information creating a confusion. The words in parentheses are those which appeared in the "nonconfusing" versions of the passages read by control subjects. The nature of each confusion will be considered in the Results and Discussion section of the paper.

Insert Table 1 about here.

It should be noted that these passage confusions were constructed on an intuitive level. Since the study was primarily exploratory, systematic criteria for determining confusion type and level were not established. In addition, the fact that different types of confusions were used should not be construed as an attempt to gain information about the role of specific confusion types in comprehension monitoring. Rather, different confusion types were used in order to reduce the likelihood that subjects would catch on to the fact that each passage contained a confusion. Since there was only one passage for each confusion type by level combination, we obviously cannot make generalizations about specific cells in the design. In presenting the results, the confusions will be considered separately, but this is more for expository purposes than statistical.

Procedure

The experiment consisted of three parts: (a) Study. Subjects were instructed to read all six passages carefully in preparation for subsequent "discussion" questions. They were allowed to spend as much time on each passage as desired, but were not allowed to reread previous passages.

Subjects were not informed of the existence of the confusions at this time. (b) Probed recall. Subjects were asked to answer "Describe and evaluate" questions dealing with the target paragraph of each passage. These questions are included in Table 1. The questions were designed to encourage complete recall of the target paragraph and exclude recall of the surrounding paragraphs. Subjects were not permitted to look back at the passages. It is important to stress that the recall task is not intended to provide a measure of confusion detection, since subjects are free to construct answers to the questions using whatever criteria they choose. However, the recall protocols should be useful in revealing whether subjects modified the confusions in some way to render them more sensible. Thus, the results of interest from the recall task are qualitative rather than quantitative. We are not so much interested in the amount of information subjects included in their answers, but rather the nature of the information. In presenting the results of the recall task, we will briefly consider quantitative aspects by comparing the amount of confusion-related information included in the responses of the experimental and control subjects. However, the recall responses are of primary interest for the light they shed on the strategies subjects used during reading. The recall protocols will be considered from this perspective in the final section of the paper. (c) Detection. The subjects were informed of the existence of the confusions, and the three types were described. They were asked whether they had noticed the confusions during their initial reading of the passages and, if not, were given an opportunity to seek them. Additional questions

probed how the confusions affected processing of the passage and subsequent recall. These questions, included in Appendix B, are admittedly leading, but the best way to get subjects to reflect upon their strategies is to give them some examples of what is meant by strategy. The ideal technique would be to interview students individually, but even here, some leading questions would be needed in order to elicit task-relevant responses. Subjects were then asked to provide comprehensibility and familiarity ratings of each passage. Complete instructions to the subjects are presented in Appendix A.

Fourteen University of Illinois undergraduates enrolled in an educational psychology course served as subjects in the experiment just described. Eight additional subjects read the consistent versions of each passage and answered the same probed recall questions. The detection questions were replaced by some general questions about the interest level, clarity, and reading difficulty of the passages, but comprehensibility and familiarity ratings were again requested. The control subjects were included in order to compare recall and ratings of the confusing and non-confusing versions of the passages.

All of the materials necessary for the experiment were contained in a single booklet, along with complete instructions. The order of the passages was randomly determined for each booklet, with the order of questions in Parts 2 and 3 the same as the order of the passages. Subjects were run in two sessions, and they went through the booklets at their own pace. Average completion time was 40 minutes.

Results and Discussion

This section of the paper is divided into five parts. The first part describes the nature of the confusions in each passage and the frequency of their detection. The second part compares the responses of the experimental and control subjects on the probed recall task. The third part reports the comprehensibility and familiarity ratings, and the fourth reports a test for correlations among the dependent variables. The final section examines several procedures for dealing with the confusions as revealed through analysis of the recall protocols and retrospective reports.

Confusion Detection

Subjects' responses to the questions in part 3 were scored as to whether or not they detected the confusions. In general, subjects were quite poor at detecting the confusions; only 38% of the confusions were reported, even after subjects were explicitly instructed to search for them.

Insert Table 2 about here.

Subjects, claimed to have noticed 23% of the confusions during initial reading. These figures suggest a rather low level of comprehension monitoring. However, as will become clear later in the paper, failures to report the confusions were often due to factors other than poor comprehension monitoring. In other words, confusion detection cannot be taken as the sole index of comprehension monitoring, since subjects who "repair" the confusions are also comprehension monitors.

Table 2 presents the proportion of total detections for each passage, as well as the proportion of detections said to occur during reading. Overall, 62% of the main point confusions were detected while only 14% of the detail confusions were detected. An analysis of variance revealed that this difference was reliable, $F(1,13) = 68.42$, $p < .001$, supporting the initial expectation that main point confusions would be easier to detect than detail confusions. The apparent tendency to monitor one's understanding of main points more carefully than of details is supported by the explanations subjects provided for their failures to detect detail confusions. That is, subjects often explained that they had been reading for general ideas or decided the point was trivial. There were also reliable differences in the effect of confusion type, $F(2,26) = 8.99$, $p < .001$; inappropriate connectives were detected less frequently than inconsistencies or vague references, which did not differ in their detectability. The poor detection of inappropriate connectives was due to the fact that many subjects classified the problem as one of inconsistency. This point will be elaborated in the following discussion focusing on the individual passages. There was also a significant confusion type by level interaction, $F(2,26) = 4.87$, $p < .05$, which is due to the poor detection of the main point inappropriate connective. Since this interaction is confounded with passages (each cell in the design was represented by only one passage), it is not readily interpretable.

Inconsistencies. A main-point inconsistency was introduced into the "The Empire of the Inca" passage. The first sentence contains the

information that sets up the inconsistency: the claim that the economy was backward. Although subsequent statements do not explicitly contradict this, they do provide disconfirming evidence: A backward economy is unlikely to have such successful farming efforts and no unemployment. This confusion was quite salient, as 10 of the 14 subjects noticed it. However, only four reported that they had noticed it during initial reading. At least one reason for the low during-reading detection rate was that many subjects made inferences to resolve the inconsistency; e.g., they assumed other aspects of the economy were backward. This point will be elaborated in the retrospective reports section.

The detail-level inconsistency appears in the "Great Renaissance Artists" passage in the statement that da Vinci's sketches lacked any future practicality. Considering the fact that the sketches of airplanes were done in the 16th century, they were actually quite remarkable portents of the future. This inconsistency probably cannot be detected on the basis of text information alone; the reader needs to know that the Renaissance took place hundreds of years ago and that airplanes did not exist until the 20th century. We felt reasonably sure that college students would possess this relevant background knowledge, but as it turned out, some of them had too <u>much</u> background knowledge. They knew enough about da Vinci's sketches to know that his airplanes weren't practical, that they couldn't possibly fly. Thus, they brought in their prior knowledge to interpret this statement, thereby resolving the intended inconsistency. Because only three subjects reported the inconsistency, some colleagues were asked for their opinions

about the passage; it was only then that the alternative yet plausible interpretation was discovered.

Unclear references. The "Literature of the Spanish Renaissance" passage contains a confusion of unclear reference at the main point level. The problem with the text was that the novel which had the greatest impact was never specified: "only one type . . . It would typically describe . . ." This vagueness was readily detectable: Thirteen subjects reported it and ten of the thirteen noticed it during reading. This provides further evidence that the identification of referents is a process which occurs during reading (Garrod & Sanford, 1977).

The reference confusion at the detail level appeared in "Political Development of Ancient Greece." There were two vague referents in the final sentence of the paragraph; it is not clear whose hold was broken, nor who paved the way for democracy. This vagueness was not a concern for most subjects; only two reported the confusion. However, three subjects reported an inconsistency in the statement that the tyrants were benevolent, detecting a conflict with their prior knowledge about tyrants. Although it is true that tyrants are frequently oppressive or brutal, this is not a defining characteristic. Since the reference problem was not very salient, subjects looked for a confusion elsewhere in an attempt to comply with task demands.

Inappropriate connectives. The "Byzantine Civilization" passage contains an inappropriate logical connective at the main point level. The word "therefore" at the beginning of the second sentence signals a logical,

causal relationship between the ideas in the first and second sentences, while the appropriate connective, "however," signals an exception or change in the direction of thought. Only three subjects reported that "therefore" was inappropriate, but four reported that the ideas in the two sentences were inconsistent. The inconsistency was explained as follows by a typical subject: "The passage at first says the architecture was modeled after the Greeks but then it says it was unique." Note that this explanation confuses "culture" with "architecture." These subjects apparently failed to consider that architecture is but one aspect of a country's culture. Had they done so, they perhaps would have focused more on the inappropriateness of the transition word.

The "French Religious Wars" passage contained an inappropriate logical connective at the detail level, but subjects again reported the confusion as one of inconsistency. The inappropriate connective was "therefore" in the final sentence of the paragraph. "However" is a more appropriate term, since it does not follow from preceding context that Catherine would join the conspiracy. What the subjects did pick up on as a confusion was Catherine's inconsistent behavior: If she supported the Huguenots, why did she conspire against them? Ten of the fourteen subjects reported this as the confusion while only one attributed it to an inappropriate logical connective. In contrast to the Byzantine passage, where the reported inconsistency was based on insensitivity to the culture-architecture distinction, the reported inconsistency in this passage was not based on misunderstanding; Catherine's behavior did seem inconsistent on the basis of

the information given in the passage. This suggests that people are more likely to attribute errors to the semantic relationship among ideas than to question the appropriateness of logical connectives.

Recall of Confusion-Related Information

The probed recall questions for each passage are included in Table 1. Subjects' responses to the questions were scored for "target relevance;" i.e., for those statements based on the confusing aspects of the paragraph. This included the sentence which contained the confusion manipulation itself as well as supporting information involved in setting up the confusion. A lenient scoring criterion was used, counting as target-relevant any statement that was a paraphrase, elaboration, modification, or distortion of the explicit information. (Note that this includes incorrect statements of the confusing information; e.g., the economy was "advanced" rather than "backwards.") In order to determine whether the presence of a confusion affected the likelihood of target-relevant recall, a comparison was made with the subjects who had read consistent versions of the passages. The same criteria were used in scoring the responses of the control subjects.

The proportions of target-relevant responses are presented in Table 3,

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Insert Table 3 about here.

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as a function of condition (experimental vs. control), confusion type, and level. Overall, 40% of the experimental responses contained target-relevant information while 56% of the control responses did. An analysis of variance

showed that this difference approached but did not reach significance, $F(1,20) = 3.11$, $p < .10$. One explanation for this 16% difference in recall was that the experimental subjects knew a confusion was present and so decided to omit mention of it. In fact, several subjects reported such deliberate response suppression. Another reason is that subjects remembered less information as a result of the confusion; this is supported by several comments that the confusion impaired memory. There were no differences in recall of main point or detail level information, but there was a reliable effect of confusion type, $F(2,40) = 5.62$, $p < .05$, with the unclear reference passages worst recalled, and the inappropriate connectives passages best recalled. There was also an interaction of confusion type and level, $F(2,4) = 12.98$, $p < .001$. However, since there were no interactions with experimental condition, the differences are likely due to characteristics of the passages themselves rather than to the presence or absence of a confusion.

Comprehensibility and Familiarity Ratings

Subjects were asked to rate the comprehensibility and familiarity of each passage on a scale from 1 to 5, with 1 representing the lowest level and 5 the highest. Analyses of variance were performed on the ratings with condition (experimental vs. control) and passage as factors. Since it was assumed that the ratings would vary considerably across passages, the analyses were conducted with passage as a factor rather than confusion type and level. The mean comprehensibility and familiarity ratings for each passage are presented in Table 4, classified by experimental condition.

Insert Table 4 about here.

The mean overall comprehensibility rating for the experimental subjects was 3.26 and for the control subjects, 3.65, a nonreliable difference. Thus, the presence of a confusion did not result in decreased comprehensibility of the passages. However, the effect of passage was reliable, $F(5,100) = 5.91$, $p < .001$. Multiple comparisons revealed that the Literature passage had a significantly lower rating then all but the Byzantine passage. The ratings for the Greek, Artist, Wars, and Inca passages did not differ significantly. The ratings parallel the probed recall results in that the Literature passage, which was poorly recalled, was rated lowest in comprehensibility, and the Inca passage, which was well recalled, was rated high in comprehensibility. The analysis of variance also revealed a significant passage by condition interaction, $F(5,100) = 2.32$, $p < .05$, due to the fact that the control subjects gave the Wars passage their highest rating, while the experimental subjects gave it one of the lowest.

The familiarity ratings for the experimental and control conditions did not differ significantly (2.23 vs. 2.29, respectively), nor did condition interact with passage. The effect of passage was reliable, $F(5,100) = 8.82$, $p < .001$. The Literature passage, which had the lowest familiarity rating, was reliably different from the Inca, Artist, and Greek passages. The Greek passage, which had the highest rating, was reliably different from the

Literature, Wars, and Byzantine passages. The low rated familiarity of the Literature passage may also have been a factor in its low level of recall.

Tests for Correlations Among the Dependent Variables

Correlational analyses were carried out to test for systematic relationships among the four dependent variables (recall, detection, rated comprehensibility, and rated familiarity). Since the control subjects did not contribute detection data, they were not included in the analyses. A correlation matrix based on mean scores for each subject collapsed over passages is presented in Table 5. The comprehensibility and familiarity ratings were positively but not significantly correlated. Thus ratings of higher comprehensibility were usually accompanied by ratings of high familiarity, and similarly with low ratings. There was also a positive correlation between recall and detection, but again it was nonsignificant. Thus, subjects were somewhat more likely to detect a confusion if they recalled it and were less likely to detect a confusion if they did not recall it. Separate correlation matrices were also constructed for each passage, but of the 36 correlations, only three were significant at the .05 level and two others were marginal ($p < .10$). These results therefore do not warrant further consideration.

Insert Table 5 about here.

Retrospective Reports and Inferences Based on Recall

The quantitative analyses revealed that subjects were quite poor at detecting the intended confusions. Even though subjects were explicitly told that confusions were present and were given examples of the three confusion types, the detection rate was only .38. Subjects reported that they had noticed 23% of the confusions as they were reading the passages for the first time. This figure, of course, is based only on subjects' retrospective verbal reports but, if erroneous, is more likely to be too high than too low. That is, subjects are probably more likely to say they noticed the confusion initially if in fact they did not than they are to say they did not notice the confusion initially if in fact they did.

The low detection rate was partly due to the fact that many inappropriate connective confusions were identified as inconsistencies, indicating that subjects were better comprehension monitors than the data suggest. If these detections are included in the totals, the overall detection rate increases to .55 and the during-reading rate to .34. Thus, subjects did test ideas for their consistency with one another, but focused more on the concepts themselves than on the way they were logically connected in the text. Another reason for the low detection rate was that subjects often spontaneously used "fix-up" procedures to resolve the potential confusions without realizing they had done so. The use of fix-up procedures was discovered through inspection of the recall protocols and the retrospective reports subjects provided after being informed of the existence of the confusions. This information cannot be characterized

quantitatively, but is clearly of importance in the study of comprehension monitoring. This section of the paper will describe some of these monitoring procedures.

The most frequent procedure was to draw upon prior knowledge to supplement explicitly presented information. For example, many subjects decided that some relevant information had not been included in the text and so used prior knowledge to bridge the gap. This inferencing strategy was often applied in dealing with inconsistencies, as the following excerpts from protocols on the Inca passage demonstrate. When asked to recall the paragraph, many subjects modified the information to be more consistent with the general idea of a favorable economic situation. For example, one subject recalled; "The economic condition of the country was fairly developed and efficient." Another recalled; "The economy seemed like it worked very well, at least in their own society." In post-test questioning she explained her interpretation of the inconsistency: "The economy could still be backward yet have excellent equipment." A different subject explicitly included a resolving inference in her recall response: "The economy was backward . . . . Although they possessed relatively modern technology, they were not organized in an efficient economic manner." Another student's explanation of how he dealt with the confusion was: "I thought another part was backward (such as distribution) and the author just failed to explain it."

Even though the correlational analyses did not reveal a consistent relationship between rated familiarity and detection, prior knowledge

clearly played a role in interpreting the confusions. One subject, who indicated by a familiarity rating of 4 that she had a fair amount of knowledge about the Incas, evaluated the initial statement of "backwardness" with respect to her prior knowledge rather than the content of the paragraph itself: "The culture would not be backward for its time." This interpretation is reflected in the way she qualified the inconsistent statement in her recall response: "The economy is 'backwards' as we know it today."

Prior knowledge also contributed to detection failures. A recall protocol from the Artists passage shows that the subject imposed a consistent interpretation upon the confusion: "He was ahead of his time in that he had paintings of space ships and tanks, but they are impractical in today's world." Because the subject had prior knowledge about da Vinci's sketches, the text did not seem inconsistent either upon initial reading or when instructed to reread the passage in search of a confusion.

A related cause of detection failure is assigning alternative interpretations to the text. Thus, readers may feel they understand but in fact do not get the meaning the writer intended to convey. For example, one subject distorted the information in her recall of the Wars passage such that Catherine "worked to get rid of anyone who didn't believe in religious freedom." This subject's misunderstanding of the passage probably accounts for her failure to detect the confusion. She had apparently imposed her own interpretation on the material so firmly that no other interpretation could be seen.

Subjects who did notice confusions during reading dealt with them in various ways in their recall attempts. Some subjects included the confusing information in their answers in a more or less verbatim manner, even though they knew it was not sensible, as did the subject who recalled, "The economy of the Incas was extremely backwards." They often made inferences to help resolve the confusions, but deliberately omitted them in recall. For example, in the Literature passage, one subject discussed the type of novel that had an impact in the same vague way it was discussed in the text. When asked how detection of the confusion influenced her reading of the passage and subsequent recall, she repoted: "I made the description apply to one of the kinds of novels for myself but I didn't include my rationalization in the answer."

Another way of dealing with the confusions in recall was to deliberately omit mention of them. Several subjects who noticed the inconsistency in the Wars passage made deliberate modifications in their protocols such that the inconsistent nature of Catherine's behavior was not mentioned. One subject reported: "I tried about three times to make sense of it. I assumed the writer made a mistake. I transformed it to make sense in recall." Even the subjects who did mention the inconsistency in Catherine's behavior often made subtle changes that helped explain it. For example, one subject recalled: "Catherine wanted to allow for religious freedom but this did not work. So she plotted . . ." When asked later about her understanding of this inconsistency, she wrote: "I figured she felt the situation was getting too bad . . . I tried to make sense out of it

and read more into it than was there, I guess." Three other subjects also indicated that Catherine tried to hold out against the nobles but finally had to give in to their constant pressure. One of these gave the following account of her attempts to deal with the passage: "I tried to figure out what was going on, but I couldn't. So when I answered the question, I made the information fit. The whole passage really confused me."

In some situations, the lack of prior knowledge about a topic and the inability to draw clarifying inferences may actually facilitate confusion detection. This was demonstrated in the Literature passage, which was poorly recalled and rated low in comprehensibility and familiarity, but had the highest detection rate. Most of the subjects knew something was wrong with the passage as they were reading it, and they tried but failed to impose a coherent meaning upon it. Four of them later attributed their inadequate recall answers to the confusion: "I tried to figure out what the reference was to . . . got mixed up in answer;" "I tried but couldn't decide what the author was taking about. Maybe that's why I couldn't remember anything about the passage;" "I didn't know how to interpret it, so I just read on . . . It had an influence on not remembering as much about the passage;" "I felt as if I missed a large part of understanding the article. I wasn't able to remember all three types of novels probably because that part of the article didn't make sense to me."

All of these protocols demonstrate the problem solving behavior that people engage in during reading. In their effort towards understanding, they made inferences and assumptions, as well as selectively omitting or

transforming information, to come up with a plausible interpretation of the passage. Many of the subjects did so without awareness, and only upon being informed of the existence of a confusion did they detect one. Such was the case in the Inca passage, where ten subjects reported the confusion but only four noticed it during reading. In contrast, virtually all the subjects who reported an inconsistency in the Wars passage noticed it during reading. In fact, two subjects even expressed their failure to understand in the recall protocols themselves. One subject wrote: "Catherine believed in religious freedom. It also said she conspired with the nobility, which didn't make sense to me." The other, after stating that Catherine first supported the Protestants then sided with the Catholics, commented: "Story did not see clear here. Since the subjects did not know at the time of recall that confusions had been deliberately included in the text, these comments provide clear evidence of comprehension monitoring during reading.

The comprehension monitoring behaviors just discussed are essentially content-specific. That is, they deal with the prior knowledge a reader can bring to bear on a particular segment of text to render it more comprehensible. Comprehension monitoring also involves more content-free behaviors and decisions. For example, a common response upon first encountering a confusion was to reread previously read information, checking to see if some crucial bit of information had been overlooked. Another strategy was to make a mental note that a problem had occurred, but to continue reading in the hope that clarification would occur later in the text. Two subjects verbalized this type of response. One subject noticed

an inconsistency as he was reading and reported: "I figured there was a reason for it, that I would find out later." Another said: "I kept waiting for an explanation." Thus, the subjects exhibited some faith in the writer to resolve the inconsistency at a subsequent point in the text. Although they noticed a problem, they continued reading to seek clarification. Since readers have a right to expect clarity from an author, such behavior is an adaptive comprehension monitoring strategy. The reader who becomes bogged down in a confusing section of text that could have been clarified with continued reading is technically a comprehension monitor, but is not employing an appropriate "fix-up" strategy.

Another component of comprehension monitoring involves setting a criterion for deciding when comprehension is adequate. The retrospective reports revealed that the subjects did make such decisions. Some reported that they realized there was a problem but decided it was trivial and not worth the effort of trying to resolve. Others explained that they were reading for general ideas and so understood the main theme even if a single sentence seemed to be in conflict. For example, one subject who noticed the ambiguity in the Literature passage was not terribly bothered by it: "It didn't matter much. I did understand that eventually democracy was implemented."

Criterion explanations were also typical of subjects who did not notice the confusions during reading but detected them when informed of their presence. When subjects who reported an inconsistency in the Byzantine passage after reading were asked why they thought they had not noticed it

initially, one subject wrote: "I ignored the first sentence thinking it was unimportant. I was reading for general ideas." Another was: "Not too interested in art--just looking for general ideas." And another explained: "I understood the passage so the sentence didn't really confuse me or enter my mind." This strategy of reading for general ideas can also account for failures to detect confusions altogether.

The behavior of one particular subject is worth examining because it represents a processing strategy mature comprehenders are not supposed to engage in. The subject did not detect the confusion in the Inca passage until instructed to find it, and he offered this explanation for his failure to notice it initially: "The confusion was obvious, but I read the material as individual sentences, not paragraphs, so I wasn't bothered by it. It was just two separate pieces of information." The subject also failed to notice the Byzantine confusion until instructed to do so and explained: "I was just trying to collect facts. I didn't put them together as a whole." Thus, another cause of detection failure is reading sentence by sentence without integration across sentences. Since all of the confusions required consideration of two or more sentences, integration was essential. This subject did reasonably well in answering the recall questions, however, showing that his low-level strategy was sufficient for the explicit task demands.

Finally, the retrospective reports also revealed some ways of reacting to the confusions that were not oriented towards fixing up the difficulties in comprehension. One of these was to attribute the confusion to an error

on the part of the author or typist and make no attempts to interpret it. For example, one subject's reaction to the ambiguity in the Literature passage was: "I thought it was an omission, like maybe a sentence had been left out. I just went on reading though." Another was for subjects to blame themselves for not understanding the confusing information. For example, a subject's description of how she dealt with the Wars confusion was: "I merely interpreted it as correct and assumed I had misread something previous." Perhaps the least adaptive response of all was made by a subject reading the Wars passage who: "more or less got frustrated and just threw my hands up."

Summary and Conclusions

The present study explored the comprehension monitoring abilities of college students. Subjects read and recalled texts containing intentionally introduced confusions. They were subsequently informed of the existence of the confusions and were asked to report them. Additional questions called for retrospective reports on how the confusions affected comprehension. Three types of confusions were studied: inconsistent information, unclear references, and inappropriate connectives. The confusions involved either the main idea or a detail of the target paragraph. A control group read and recalled the passages in their "nonconfusing" versions. All subjects also rated the comprehensibility and familiarity of each passage.

The study provided several results of interest: 1. Subjects failed to report a surprisingly large proportion of the confusions (62%), and less than one quarter of the confusions were reported noticed during reading. As

expected, however, main idea problems were more noticeable than detail problems. In addition, subjects were more successful at detecting inconsistencies and vague referents than inappropriate connectives. In fact, connective confusions were often classified as inconsistencies. This latter outcome warrants further investigation, since it is not clear whether connectives had so little salience that subjects simply ignored them or that they had so much salience that they carried the interpretation of the sentence.

2. The presence of a confusion did not significantly decrease the amount of information recalled from the target paragraph, though there was a trend in this direction. Subjects retrospectively reported that they sometimes deliberately omitted or transformed information that was confusing, and they also felt that the confusions sometimes impaired their memory for the material. These findings demonstrate that recall measures alone often do not provide sufficient information about how well subjects comprehended text, since most subjects were selective in what they included in their answers.

3. The presence of a confusion did not reduce the overall comprehensibility rating of a passage, nor did familiarity ratings differ between the experimental and control groups.

4. There were no significant correlations among any of the dependent variables, though there were small positive correlations between the comprehensibility and familiarity ratings and between recall and detection.

5. The retrospective reports and inferences drawn from the recall protocols reveal the variety of ways readers can impose sense on potentially confusing information. This indicates that failure to report a confusion is not in itself a sensitive index of comprehension monitoring, since subjects often made inferences to resolve the confusions without realizing they had done so. Moreover, their purposes for reading were not always compatible with the implicit task demand of confusion detection; e.g., they were reading for general understanding. Clearly, it is not enough to know whether or not a confusion was detected; one must also know how the information had been interpreted and how extensively it had been processed. The sophistication with which skilled readers approach the task of comprehending can be a serious pitfall in the study of comprehension monitoring. The spontaneous use of fix-up procedures may lead to a spuriously low estimate of comprehension monitoring, but this same behavior may lead readers to feel they understand when in fact they do not.

In conclusion, the study has shown that college students can and do monitor their comprehension, though not always consistently. If they experience difficulty in understanding, they have a variety of procedures available to assist them in coming up with a plausible interpretation of the text. Moreover, these procedures are sometimes applied so automatically that readers are unaware that their interpretation of the text may not be the one the author intended to convey. Finally, there are large individual differences in the way readers monitor their comprehension. Thus, it appears that the question of interest in further investigations is not

whether readers monitor their comprehension, but rather how they monitor it. It remains to be determined whether skilled readers monitor their comprehension more effectively than less skilled readers.

One educational implication of the study is based on the finding that many subjects who did not notice the confusions during reading were able to detect them when specifically instructed to do so. This suggests that although many students are capable of comprehension monitoring, they do not always do it on their own initiative. This lack of motivation for careful reading may stem from exposure to poorly written material and an unquestioning belief in the printed word that is reinforced by teachers who treat the assigned textbook as the source of the "right" answer. One additional factor is that understanding is often monitored by external agents rather than by the students themselves. Schallert and Kleiman (1979) and Wertsch (1978) report that teachers assume much of the responsibility of cognitive monitoring for children, keeping track of what they know and do not know, what they understand and do not understand, and in other ways guiding them through the attainment of some goal. Even when students reach high school and college, much of the burden of comprehension monitoring is absent. For example, students engaged in computer managed instruction (CMI) do not have to ask themselves if they understand the material; the computer informs the students during each encounter whether or not they understand (Anderson, in press). Similarly, programmed instruction (PI) textbooks eliminate the need for self-questioning by guiding students step-by-step through the learning process.

There are both advantages and disadvantages to this educational practice of monitoring students' comprehension for them. On the one hand, it ensures that students understand the material by keeping a careful check on their understanding and providing appropriate measures for clarifying comprehension failures. On the other hand, it may foster passive reading and study habits: Why should students make the effort of checking their understanding when someone else will do it for them? In fact, the programmed techniques were originally developed because many students did not do well with traditional textbook-lecture formats. Perhaps this could have been avoided had the students learned efficient comprehension monitoring strategies when they were younger.

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Footnotes

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[1]It was discovered after the experiment was conducted that the distinction between main-point and detail confusions does not hold for the inappropriate connectives passages.

Table 1

Target Paragraphs and Probe Questions

Inconsistencies

Main Point: The Empire of the Inca

The Inca economy was extremely backward (advanced)[a] for its time. The chief occupation and source of income was farming. Farming methods were quite sophisticated and included scientific irrigation, fertilization, and use of terraces. Agricultural products were therefore plentiful and of good quality. A fundamental requirement of the government was that every able-bodied subject must pay taxes. These taxes were paid through labor rather than through a medium of exchange. As a result, unemployment was virtually absent.

Question: Describe and evaluate the economy of the Inca Indians.

Detail: Great Renaissance Artists

Another great artist, Leonardo da Vinci, is, perhaps, the supreme example of the "universal human" of the Renaissance. He was proficient in painting, sculpture, architecture, engineering, anatomy, physiology, botany, and mathematics. Within his notebooks can be found sketches of flying machines and war machines--including a tank and a parachute--as well as accurate drawings on anatomy and optics. These sketches lacked any (had great) future practicality but (and) have become well-known to many people. His notebooks, as well as many of his paintings, have been displayed in art museums around the world.

Question: Describe and evaluate da Vinci's contribution as a Renaissance artist.

Table 1 Cont'd

Unclear References

Main Point: Literature of the Spanish Renaissance

Three types of novels surfaced at this time--namely, the chivalry novel, the picaresque novel, and the pastoral novel. But only one type (the pastoral) had any significant impact upon Spanish culture. It would typically describe idealistic and highly imaginative regions, while including love plots that were often complicated. The first was La Diana which was published in 1559 by Jorge de Montemayor. Although more were published, La Diana is considered by many to represent the best of those that appeared.

Question: Identify the three types of novels and the impact of this form of literature on Spanish culture.

Detail: Political Development of Ancient Greece

There were three types of early political rule in Greece. The first major rulers were monarchs, who succeeded to the throne on the basis of heredity. The kings claimed they were descended from the gods, but their authority was not absolute. The next rulers were aristocrats, who set up oligarchies (rule of the few). The nobles gained control of the good land, and the common people were generally left out of political participation. The oligarchies were replaced by tyrants, who gained their power by force. Although these rulers were dictators, they were often benevolent. They gained popularity when they took up the cause of the poor and underprivileged. By breaking their (the aristocrats') hold, they (the tyrants) paved the way for the appearance of democracy.

Question: Identify and describe the phases of early political rule in Greece.

Table 1 Cont'd

Inappropriate Connective

Main Point: Byzantine Civilization

Byzantine culture was largely modeled after the Greeks. Therefore, (However,) the Byzantines developed a unique style of architecture which greatly influenced Europe and the Near East. The Orthodox Churches were the best expressions of the Byzantine style, and were distinguished by majestic vaults and domes. The interiors of the churches were decorated with mosaics and frescoes. The church of Hagia Sophia in Constantinople is the masterpiece of Byzantine architecture. Its most impressive feature is its huge 100-foot diameter dome with 40 windows.

Question: Describe and evaluate Byzantine architecture.

Detail: French Religious Wars

Severe persecution of the French Protestants began during the reign of Henry II. After his death, Catherine de Medici, his wife, ruled as regent in place of their ten year old son. Catherine soon established a policy to encourage free exercise of all religion. In spite of the efforts to affirm freedom of worship for the Huguenots, the nobility continued to persecute the Protestants. In 1572, the Guise family plotted to murder the Huguenot leaders who were to gather at a religious rally in Paris. In spite of continued and extensive pressure such as this, Catherine steadfastly supported religious freedom for the Protestants. Therefore, (However,) she conspired with the Guise family in planning this attack which would come to be known as the St. Bartholomew Massacre.

Question: Describe Catherine da Medici's relationship with the Huguenots and the French nobility.

[a]Words in parentheses appeared in consistent versions of the paragraphs.

Table 2

Proportion of Subjects Detecting Intended Confusions

Intended Confusions	Total	During Reading
Inconsistencies		
Main Point (Incas)	.71	.29
Detail (Artists)	.21	.07
Ambiguous References		
Main Point (Literature)	.93	.71
Detail (Greeks)	.14	.14
Inappropriate Connectives[a]		
Main Point (Byzantine)	.21	.00
Detail (Wars)	.07	.07

Note. n = 14

[a]If inconsistency detections (see p. 13) are included, the figures for the Main Point passage are .50 for total and .14 for during reading. The detail figures are .79 and .71.

Table 3

Proportion of Target-Relevant Recall Responses

Intended Confusions	Experimental	Control
Inconsistency		
Main Point (Incas)	.64	1.00
Detail (Artists)	.21	.13
Ambiguous Reference		
Main Point (Literature)	.21	.25
Detail (Greeks)	.36	.50
Inappropriate Connective		
Main Point (Byzantine)	.36	.50
Detail (Wars)	.64	1.00

Note. $n = 14$ for experimental group, $n = 8$ for control group.

Table 4

Mean Comprehensibility and Familiarity Ratings

	Comprehensibility		Familiarity	
	Experimental	Control	Experimental	Control
Incas	3.79	4.13	2.61	2.50
Artists	3.50	3.71	2.79	2.38
Literature	2.82	2.31	1.50	1.25
Greeks	3.50	4.15	2.89	3.50
Byzantines	3.04	3.38	1.93	1.88
Wars	2.93	4.25	1.68	2.25
Overall	3.26	3.65	2.23	2.29

Table 5

Correlation Matrix

	Rated			
	Comprehensibility	Familiarity	Recall	Detection
Rated Comprehensibility	1.00			
Rated Familiarity	.32	1.00		
Recall	-.06	.05	1.00	
Detection	-.02	.04	.23	1.00

Note. An r of .514 is required for $p < .05$.

Appendix A

Instructions to Subjects in Comprehension Experiment

The first section of this booklet contains six short passages about world history topics. You should read each passage carefully, as though you were studying for a test. You may read each passage as many times as you wish before going on to the next one. You may underline or mark the passages as you read. However, please read the passages in the order in which they are presented in the booklet and DO NOT look back to a previously read passage.

The second section of the booklet contains six "discussion" questions--one for each passage you read. Please answer each question as fully and in as much detail as you can. Please use complete sentences in your answers. Again, be sure to answer the questions in the order they appear in your booklet and DO NOT look back at the original passages.

The third section of the booklet contains questions about your comprehension of the passages that you read. More thorough instructions will be provided when you reach this point in the experiment.

If you have any questions now, or at any time during the experiment, raise your hand and the experimenter will assist you. You may take as much time as you need for any part of the experiment, and you may leave when you are through.

Instructions for Section 2

This section of the booklet contains six discussion questions--one for each passage you just read.

Answer each question fully and with as much detail as you can. Please use complete sentences in your answers.

Please answer all questions in the order in which they appear.

DO NOT LOOK BACK AT THE PASSAGES

Instructions for Section 3

Some of you may have noticed misleading or contradictory information in the passages that you read. Each of the six passages contained one such confusion, which was always located in the middle paragraph. These confusions were deliberately introduced into the passages in an attempt to discover whether they affect students' comprehension and memory of text. Don't feel badly if you did not notice the confusions during reading--they are quite subtle and most people fail to detect them unless they are specifically looking for them.

There were three types of confusions included in the passages. One type involves the use of a pronoun to refer to a previously discussed noun. In some situations, the pronoun could refer to two or more nouns, and the meaning of the sentence cannot be fully understood unless you know which noun is being referred to. A second type of confusion involves the presence of contradictory information. A particular sentence may express an idea, and a subsequent sentence may present an idea that directly or

indirectly contradicts it. A third type of confusion involves expectations that are built up about the kind of information that will follow a particular conjunction. For example, if you encounter the word "however," you expect that it will be followed by information which somehow contrasts or modifies previous information. You would be surprised if the new information simply supplemented previously stated ideas.

This final section of the booklet contains six questionnaires related to the six passages you have read. Please answer the questions for each passage as accurately as possible. The title of each appears at the top of each questionnaire.

Appendix B

Questions for Section 3

Questionnaire for (Passage Title)

#1 A. Without looking back at the passage, do you think you know what the confusion was? If YES--describe it here.

If NO--go back to the passage (same colored sheet as this page) and try to find it. Remember, the confusion is in the middle paragraph. If you can find it, describe it here.

If you failed to find the confusion, after a thorough search, please skip to question #3.

B. Which category does the confusion fall into--pronoun, contradiction, or conjunction?

C. Does the confusion involve a MAIN POINT or a DETAIL of the paragraph?

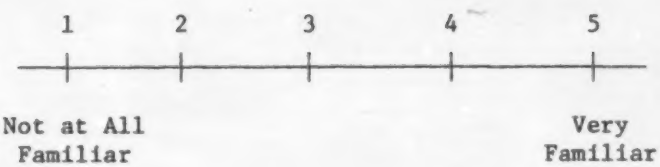
#2 Did you notice the confusion during your initial reading? If YES, go to part A (this page), if NO, go to part B (next page).

A. If YES--did you attempt to make sense of it? Did you attribute the confusion to an error on the part of the writer? How did the confusion influence the way you read the rest of the passage? Please answer in detail.

How did you deal with the confusion when you answered the discussion question in Section 3? (e.g., Did you include the confusing information even though you knew something was wrong with it? Did you deliberately omit mention of it? Did you transform the confusing information so that it made sense? Did you forget to include it in your answer?)

B. If NO--try to explain why you think you did not detect it, (e.g., Was the confusion too subtle? Was it so trivial that it didn't affect your overall understanding of the passage? Were you reading the passage for general ideas rather than going over it word for word?)

#3 On a scale of 1-5, rate your FAMILIARITY with the ideas presented in the passage.



Do you think that your prior knowledge of the topic influenced your understanding of the passage? In particular, did it make it easier (or more difficult) to detect the confusion?

CENTER FOR THE STUDY OF READING

READING EDUCATION REPORTS

No. 1: Durkin, D. *Comprehension Instruction—Where are You?*, October 1977. (ERIC Document Reproduction Service No. ED 146 566, 14p., PC-$1.82, MF-$.83)

No. 2: Asher, S. R. *Sex Differences in Reading Achievement*, October 1977. (ERIC Document Reproduction Service No. ED 145 567, 30p., PC-$3.32, MF-$.83)

No. 3: Adams, M. J., Anderson, R. C., & Durkin, D. *Beginning Reading: Theory and Practice*, November 1977. (ERIC Document Reproduction Service No. ED 151 722, 15p., PC-$1.82, MF-$.83)

No. 4: Jenkins, J. R., & Pany, D. *Teaching Reading Comprehension in the Middle Grades*, January 1978. (ERIC Document Reproduction Service No. ED 151 756, 36p., PC-$3.32, MF-$.83)

No. 5: Bruce, B. *What Makes a Good Story?*, June 1978. (ERIC Document Reproduction Service No. ED 158 222, 16p., PC-$1.82, MF-$.83)

No. 6: Anderson, T. H. *Another Look at the Self-Questioning Study Technique*, September 1978. (ERIC Document Reproduction Service No. ED 163 441, 19p., PC-$1.82, MF-$.83)

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